

## ON SOME FLORISTIC RELATIONSHIPS BETWEEN THE CANARY ISLANDS AND NEIGHBOURING AFRICA

G. KUNKEL

### GEOGRAPHICAL SITUATION

The Canary archipelago consisting of seven larger and six smaller islands is situated approximately at  $28^{\circ}$  N and  $16^{\circ}$  W and stretches some 500 km (300 miles) in a SW-NE direction. With Madeira in the north, the Azores in the northwest and the Cape Verde Islands roughly south, the Canaries are the heart of the Macaronesian group. Macro-geographically the islands are on the crossroads, between West Africa and North America, and Europe and South America. The total landmass of the archipelago consists of some 7500 qkm (2800 sq. miles), and the permanent population of the islands comprises approximately 1.2 Mill. inhabitants.

But Africa is the nearest continent. In fact one coastal stretch of Fuerteventura (eastern group) is separated only by some 100 km (60 miles) from the nearest point of the African coast. And much of the Canarian landscapes, climate and vegetation is strongly African or, more exactly, Sahara-influenced.

The Canary Islands are characterized by extreme geographical differences. This applies to the island group itself because each island differs very much, even to its nearest neighbour, and to each island in particular. Some of the larger islands, such as Tenerife and Gran Canaria, are almost perfect miniature continents: with cool and woody northern regions and the sun-baked desertic south, with alpine zones in the centre (Tenerife = 3700 m) and almost tropical cultivation in lower valleys — the diversity seems extraordinary. Of the two eastern islands, for example, which are very near to each other, Fuerteventura resembles a South Moroccan countryside whereas Lanzarote is dominated by sub-recent volcanoes and having the appearance of a lunar landscape. Differences in vegetation are accordingly.

### FLORISTIC FACTS AND PROBLEMS

The natural plant life in the Canary Islands consists of about 1700 species belonging to some 135 different families of vascular plants. Of these 17

families are Pteridophytes, 3 Gymnospermes, 20 Monocotyledoneae and 95 families belong to the Dicotyledoneae of which — with over 200 species — the Compositae is by far the largest family. Between 35 and 40% of the total number of species are considered to be endemics (Canarian or Macaronesian). This percentage keeps about stable as some so-called Canary endemics have (lately) also been found in North Africa and, therefore, are eliminated from this special list, and others (new discoveries) added. Naturally, as VAN BALGOOY (1969) pointed out: the islands are fairly well studied and “very few generic novelties to be expected”.

Although the Canary Islands have been botanically investigated since the beginning of the 19th century (a number of plants have been described as early as in 1753!), modern studies reveal that the flora and vegetation of the islands is still far from sufficiently known and such studies, therefore, are equally far from their conclusion. Only during the last decade more than 50 new species were described (mainly by E. R. SVENTENIUS 1960) and over 80 species have been published as additional taxa to the floristic list of the archipelago. Certain larger plant “groups” (i. e. *Chrysanthemum*, *Echium*, *Euphorbia*, *Micromeria*, *Senecio* etc.) are in need of critical revision. Local plant lists (of single islands) of course are still more incomplete and only during the last 5 years almost 300 additional data have been given (BRAMWELL 1970, HANSEN 1970, KUNKEL 1967—70, LID 1968, 1970, and SUNDING 1968—70).

Cytological studies have been carried out only sporadically or in connection with modern monographs, and sociological studies only during the very last years (RIVAS & ESTEVE 1965, OBERDORFER 1965, SUNDING 1970). On the ecological sector not more than some particularly interesting factors have been investigated (BORGESEN 1924, CEBALLOS & ORTUÑO 1951, DAN-SEREAU 1965—, LEMS 1968). We still rely (floristically) on classical works, such as WEBB & BERTHELOT 1836—50, CHRIST 1888, BORNMÜLLER 1904, PITARD & PROUST 1908, LINDINGER 1926, and BURCHARD 1929. On the other hand because of the new density in investigations and numerous nomenclatural changes, a very modern summary by the late KORNELIUS LEMS (1960) is already confusingly out of date.

The greatest problem arises out of the fact that the Canary Islands are neglected by larger regional works: For European scientists Europe ends at Madeira and the Canaries do not belong to the “Flora Europaea”. They are only occasionally or marginally mentioned in floristic works of North Africa and/or the Mediterranean region. We feel the need for a working connection with neighbouring North Africa (may be not very welcome by politicians), or towards Macaronesian unity.

## THE VEGETATION IN GENERAL OUTLINE

Since H. CHRIST (1885) and H. SCHENCK (1907) we accept three major clima-ecological zones for the islands: below, in and above the clouds. Each of these altitude zones bears its characteristic vegetation. However this zonation applies mainly to the central and western islands of the archipelago because the eastern islands are lower and almost totally arid in their geographical and vegetational features.

The largest region — below the cloud level — consists of the litoral and sublitoral belt, and the arid and xerophytic steppe which is rich in succulents and spiny shrubs. This formation in the southern part of the islands and usually in the rain-shadow of high ridges, may reach 800 meters in altitude, or even more. Many, often locally endemic species are recorded. In ravines and valleys palm growth is (or was) commonplace (*Phoenix*), in association with trees and bushes such as *Pistacia*, *Bosea*, *Olea* etc. *Aeonium*, *Asparagus*, *Ceropegia*, *Euphorbia*, *Hyparrhenia*, *Forsskoalea*, *Kleinia*, *Launaea*, *Lobularia*, *Linaria*, *Artemisia*, *Neochamaelea*, *Ononis*, *Plocama*, *Salvia* a. o. are the most common steppe and rock genera. The coastline itself is characterized by Mesembryanthemaceae, Chenopodiaceae, Zygophyllaceae, Frankeniaceae and some genera of other families (Compositae = *Chrysanthemum*, Plumbaginaceae = *Limonium*, Umbelliferae = *Crithmum* and *Astydamia*), many of them of North African origin or, at least, strongly connected.

The "region in the clouds" is very clearly pronounced in the northern sector of the islands where (above 400 meters) relicts of the laurisilva can still be studied. A large number of species (mainly trees and ferns) are Macaronesian endemics which also occur on Madeira and the Azores. Shrubs and herbaceous plants, on the other hand, are often Canarian endemics. Unfortunately the old Macaronesian laurel forest is widely destroyed and — on La Palma, Tenerife and Gomera — destruction still goes on. The laurel forest becomes (artificially) replaced by inferior pine woodland or *Eucalyptus* plantations. Laurel forest has not been found in the southern sector of the islands where *Cytisus* shrubland forms an open bush, in association with *Lavandula*, *Cistus*, *Carlina* and other genera. Ecologically very important (water collector!) is the endemic Canary pine (*Pinus canariensis*), found above the old laurel belt and towards the centre of the islands (except on Gomera).

The "region above the clouds" is pronounced only on the islands of Tenerife, La Palma, and Gran Canaria where altitudes above 1500 meters are recorded. Here *Micromeria*, *Sideritis* and *Cheiranthus* are common, and in some places *Cytisus* or *Cistus* occupy large areas. A formation on Gran Canaria was recently described by P. SUNDING (1969) as the Micromerio-Cytisetum congesti. Some slopes are occupied by grassland only. Endemic succulents are found on rocks which are moist during the winter season. Pine forest is no longer found growing naturally at these higher altitudes. On Tenerife, two endemic flowering plants (*Viola cheiranthifolia* and *Silene*

*noctolens*) have been recorded from slopes with extreme climatic oscillation, reaching 3500 meters above sea level.

## REMARKS ON SOME FLORISTIC RELATIONS BETWEEN THE CANARIES AND AFRICA

As mentioned in the title, a strong floristic relationship exists between the Canary Islands and Africa. This refers especially to species of the xerophytic formation and to neighbouring North Africa.

The majority of pteridophytes are Atlantic-Mediterranean elements, except *Davallia canariensis* and *Asplenium aethiopicum* which are related to African forms or may be African plants growing in the Canaries. *Adiantum reniforme* shows a strangely interrupted distribution, with its occurrence in Macaronesia and in Kenya; a similar distribution pattern has been found (HEDBERG 1961) in the genus *Canarina* (Campanulaceae). *Notholaena marantae* occurs in Macaronesia, the Mediterranean, East Africa and the Himalayas (PICHI-SERMOLLI 1963; see other data given by TARDIEU-BLOT 1946 and DANSEREAU 1961).

The North African litoral and desert elements are strongly represented in the flora of the eastern Canaries and in the drier parts of the other islands. *Aizoon*, *Arthrocnemum*, *Asphodelus*, *Atriplex*, *Beta*, *Fagonia*, *Frankenia*, *Forsskaolea*, *Gymnocarpus*, *Heliotropium*, *Herniaria*, *Launaea*, *Lithospermum*, *Mesembryanthemum*, *Periploca*, *Plantago*, *Salsola*, *Suaeda*, *Tamarix*, *Tribulus*, *Trigonella*, *Withania*, and *Zygophyllum* are present in the Canary Islands and in North Africa and are, generally, absolutely identical in both areas (see also OZENDA 1958). Other genera and species, such as *Caralluma*, *Ceropegia*, *Chenolea*, most *Chrysanthemum*, surely some *Convolvulus* and *Crambe*, species of *Globularia*, *Justicia*, *Kleinia*, *Limonium*, *Linaria*, *Lotus*, *Lyperia*, *Phyllis*, *Plocama*, *Polycarpaea*, *Prenanthes*, *Salvia*, *Schizogyne*, *Senecio*, *Smilax*, *Tolpis* and *Traganum* are suggested by LEMS (1960) as African elements represented in the Canary Islands by endemic species but related to African counterparts. Except in a few cases (i. a. *Convolvulus*, *Polycarpaea*, *Schizogyne*, *Limonium*, *Lotus*), most other species are East or South African elements, often characterized by their occurrence in mountainous countrysides. Such relationship is to be expected also for our species of *Dracaena* (but see note in CIFERRI!), *Erica*, *Parolinia*, *Campylanthus*, *Hypericum* (if not Mediterranean) and some species of *Solanum*; the Canary Date palm might be only a subspecies of the North African-Arabian *Phoenix dactylifera*, especially as a number of other forms have been found lately in the islands (KUNKEL 1970), making clear separation quite impossible.

In the case of the Canarian *Euphorbia* species such relationship seems beyond any doubt. For the true stem-succulents, such as *Euphorbia handiensis* and *E. canariensis* North and East African relations (including Socotra)

seems accepted; *E. balsamifera* and *E. obtusifolia* (including *E. regis-jubae*) are North African desert elements represented in Morocco and Spanish Sahara by the same species as in the Canaries, and *E. aphylla* might be the (smaller) Canary counterpart of the African Milk bush (*E. tirucalli*). In the Crassulaceae such relationship is not immediate (as all species of our lists are Canarian endemics) but at least all 60 some species of *Aeonium*, *Aichryson*, *Greenovia* and *Monanthes* belong to PRAEGER's (1967) "tender Sempervivums" and are very much related to the European species of *Sempervivum* sensu stricto. However they have to be taken as African elements; especially South Africa is rich in such leaf-succulents of this very same family, i. e. *Crassula*, *Rochea* and some *Sedum* species.

The plants of the old laurel forest are not easy to classify (in the sense of this paper) as most species are related to or even identical with species of the (fossil) laurisilva of Southern Europe, and they are also related to recent elements of Southern Asia (*Apollonias*), Central America (*Ocotea*, *Persea*) or even to species in East Africa (*Catba*) and Australia (*Picconia*) (see also CIFERRI 1962, and E. SCHMID 1954).

## CONCLUSIONS

The vegetation of the Canary Islands consists of almost 1700 species of vascular plants, belonging to some 135 different plant families. As many new species have been described lately and always new introductions are discovered, the study of the flora is still far from its conclusion.

The vegetation of the coastal and desertic regions of the islands is strongly related to neighbouring North Africa whereas certain plants from higher zones (including most succulents and some xerophytic rock plants) are connected with East and South African mountain floras.

## REFERENCES

- BALGOOY, M. M. J. VAN. A study on the diversity of island floras. *Blumea* 17: 139—178 (1969).
- BØRGESEN, F. Contributions to the knowledge of the vegetation of the Canary Islands (Teneriffe and Gran Canaria). *Kgl. Danske Vidensk. Selskr. Skr., Nat.-Mat. Afd. 8. R., IV, 3* (1924).
- BORNMÜLLER, J. Ergebnisse zweier botanischer Reisen nach Madeira und den Canarischen Inseln. *Bot. Jb.* 33: 387—492 (1904).
- BRAMWELL, D. Adiciones florísticas para Lanzarote and Fuerteventura. *Cuad. Bot. Canar.* IX: 14—16 (1970).
- BURCHARD, O. Beiträge zur Ökologie und Biologie der Kanarenpflanzen. *Bibl. Bot.* 98, 262 pp. (1929).
- CEBALLOS, C., & ORTUÑO, F. Estudio sobre la vegetación y la flora forestal de las Canarias Occidentales. Madrid, 465 pp. (1951).

- CHRIST, H. Vegetation und Flora der Canarischen Inseln. Bot. Jb. 6: 458—526 (1885).
- — Spicilegium Canariense. Bot. Jb. 9: 86—172 (1888).
- CIFERRI, R. La laurisilva canaria : una palcoflora vivente. — Ric. Scient. 32 ser. 2, p. I, 2 : 111—134 (1962).
- DANSEREAU, P. Études macaronésiennes. I. Géographie des cryptogames vasculaires. Agron. Lusit. 23 : 151—181 (1961).
- — Macaronesian studies: II. Structure and functions of the laurel forest in the Canaries. Coll. Bot. 7: 227—280 (1968).
- HANSEN, A. Contributions to the flora of the Canary Islands (especially Tenerife). Cuad. Bot. Canar. IX: 37—59 (1970).
- HEDBERG, O. Monograph of the genus *Canarina* L. (Campanulaceae). Svensk. Bot. Tidskr. 55: 17—62 (1961).
- KUNKEL, G. Plantas vasculares nuevas para la flora de Gran Canaria. Cuad. Bot. I 3—23 (1967).
- — Adiciones florísticas : Isla Fuerteventura. Cuad. Bot. Canar. V : 13—18 (1969).
- — Novedades en la flora canaria II. Adiciones para Gran Canaria. Cuad. Bot. Canar. IX : 60—65 (1970a).
- — Novedades en la flora Canaria III. Algunas plantas de La Palma. Cuad. Bot. Canar. X : 1—4 (1970b).
- — Novedades en la flora canaria IV. Adiciones para La Graciosa. Cuad. Bot. Canar. X : 30—37 (1970c).
- LEMS, K. Floristic botany of the Canary Islands. Sarracenia 5: 1—94 (1960).
- — Structure of vegetation in the Canary Islands. Cuad. Bot. III: 27—52 (1968).
- LID, J. Contributions to the flora of the Canary Islands. Skr. Norsk. Vidensk.-Akad. Oslo, I Mat.-naturv. Kl., n. s. 23: 1—212 (1968).
- — Notes on plants from the Canary Islands. Nytt Mag. f. Bot. 17: 1—6 (1970).
- LINDINGER, L. Beiträge zur Kenntnis von Vegetation und Flora der Kanarischen Inseln. Abh. Geb. Auslandsk. 23, R. C., 8, 350 pp. (1926).
- OBERDORFER, E. Pflanzensoziologische Studien auf Teneriffa und Gomera (Kanarische Inseln). Beitr. naturk. Forsch. SW-Deutschl. 24: 47—104 (1965).
- OZENDA, P. Flore du Sahara septentrional et central. Centre Nat. Rech. Scient., Gap, 486 pp. (1958).
- PICHI SERMOLLI, R. E. G., & CHIARINO-MASPES, V. Ricerche geobotaniche su *Notholaena marantae* in Italia. Webbia 17: 407—451 (1963).
- PITARD, J., & PROUST, L. Les îles Canaries. Flore de l'archipel. Paris, 502 pp. (1908).
- PRAEGER, L. R. An account of the *Sempervivum* group. Repr. as Plant Monogr., Lehre, 265 pp. (1967).
- RIVAS, S., & ESTEVE, F. Ensayo fitosociológico de la Crassi-Euphorbietea macaronesica y estudio de los tabaibales y cardonales de Gran Canaria. An. Inst. Bot. "A. J. Cavanilles" 22 : 220—339 (1965).
- SCHENCK, H. Beiträge zur Kenntnis der Vegetation der Canarischen Inseln. Wiss. Beitr. Dt. Tiefsee-Exp. "Valdivia" 1898—1899, II, 1/3 (1907).
- SCHMID, E. Beiträge zur Flora und Vegetation der Kanarischen Inseln. Ber. Geobot. Forschungsinst. Rübel (1953): 28—49 (1954).
- SUNDING, P. Additions to the flora of Gran Canaria. Cuad. Bot. III: 3—10 (1968).
- — The vegetation of Gran Canaria. Diss. Univ. Oslo, mimeogr., 499 pp. (1969).

- — Notes on the flora of La Graciosa (Canary Islands). Cuad. Bot. Canar. VIII: 3—9 (1970).
- SVENTENIUS, E. R. Additamentum ad floram canariensem. Inst. Nac. Invest. Agron., Madrid, 93 pp. (1960).
- — Plantae macaronesienses novae vel minus cognitae. Index Seminum, Hort. Acclim. Plant., Orotava (1968).
- TARDIEU-BLOT, M.-L. Sur la flore ptéridologique des îles atlantiques. Mém. Soc. Biogéogr. 8 : 325—347 (1946).
- WEBB, P. B., & BERTHELOT, S. Histoire naturelle des îles Canaries. III. Botanique, 2. Phytographia canariensis. Paris (1836—1850).